Three-Dimensional Audio in the Vetronics Technology Testbed

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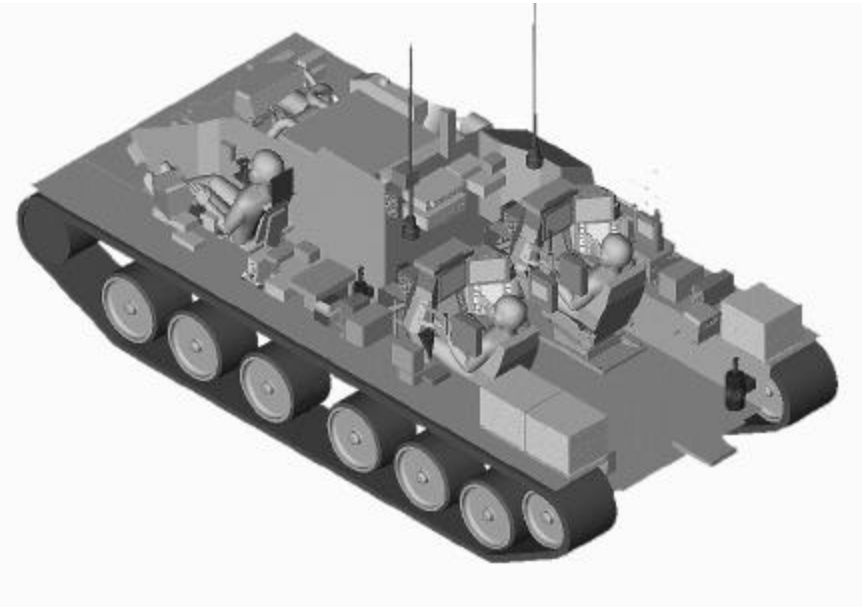
Background - Who is ASTi?

- Started in 1989
- Founders from Hughes/Sperry/CAE
- Flight Simulation background
- Extensive hardware engineering capability
- Product base was PC and DSP – now many system elements
- Growing at 15% per annum

Background – What does ASTi do?

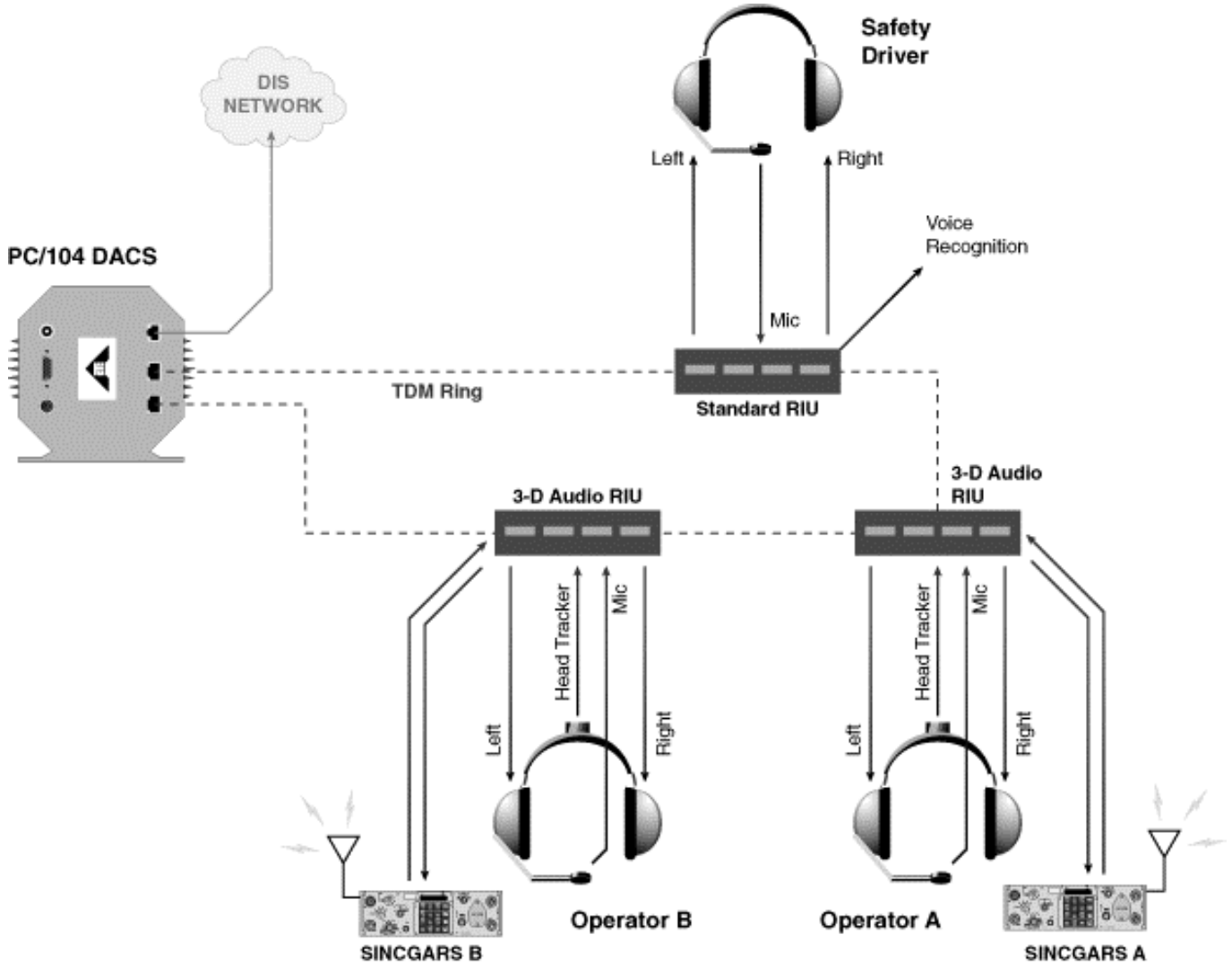
- Networked Digital Audio Communications Systems for the Simulation Industry, including:
  - DIS & HLA compatible simulated radios and intercoms
  - Aural Cues
  - Data Network –> Live Radio Network bridge (Synapse)
  - Audio Record and Playback

Vetronics Technology Testbed Overview



- Key Technologies
  - CA ATD Soldier Machine Interface
  - Speech recognition
  - Battlefield visualization
  - Three-dimensional (3-D) audio
  - Distributed electronics architecture
  - Embedded simulation
- Two crew stations + safety driver
  1. Command, control, communications, driving operations
  2. Target acquisition and servicing operations

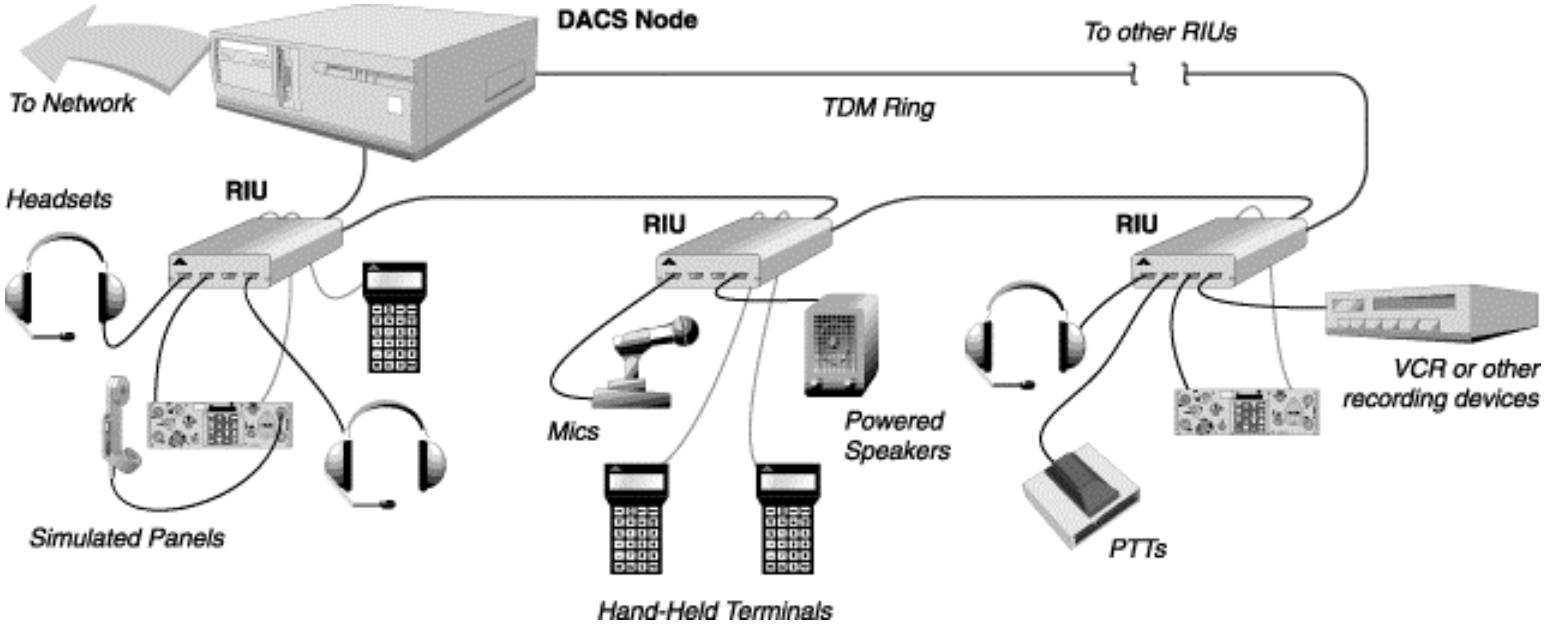
ASTi Communications System on the VTT



ASTi Communications System on the VTT, CTD

- Provides:
  - Crew intercoms
  - Warning tones
  - Interface to 2 live Sincgars radios
- ASTi Technologies used:
  - PC/104 form factor Digital Audio Communications System (DACS)
  - True Three-Dimensional Audio
  - Synapse technology for interface to live radios

Digital Audio Communications (DACS)

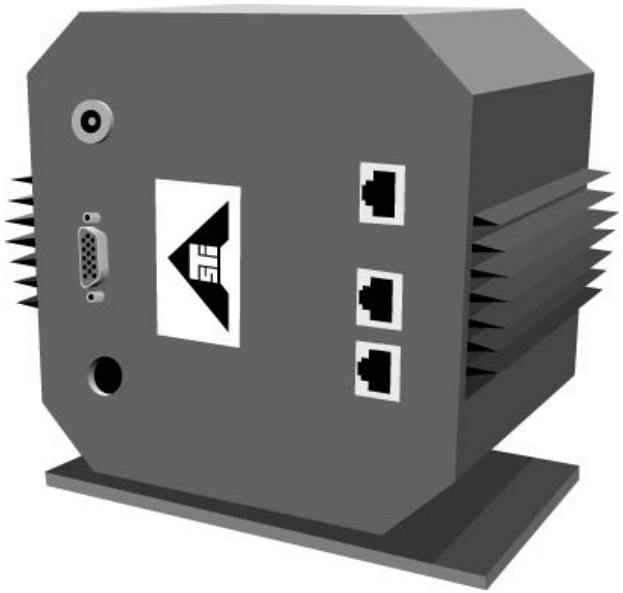


DACS Overview

- Distributed simulated radio/intercom environment
- DIS & HLA radio communication with voice compression
- Aural Cue capability
- TDM/RIU architecture allows fully digital audio distribution system
- Flexible interface supports direct connection to real audio sources

PC/104 DACS

- PC/104 form factor – industrial standard
- Compact, rugged chassis
- Made up of a “stack” of cards, cards measure 3.75” x 4.625”
- ASTi-developed custom PC/104 dsp (TDM) card, works with current RIU’s
- 64 MB compact flash storage – rugged, removable
- Same functionality as full size DACS



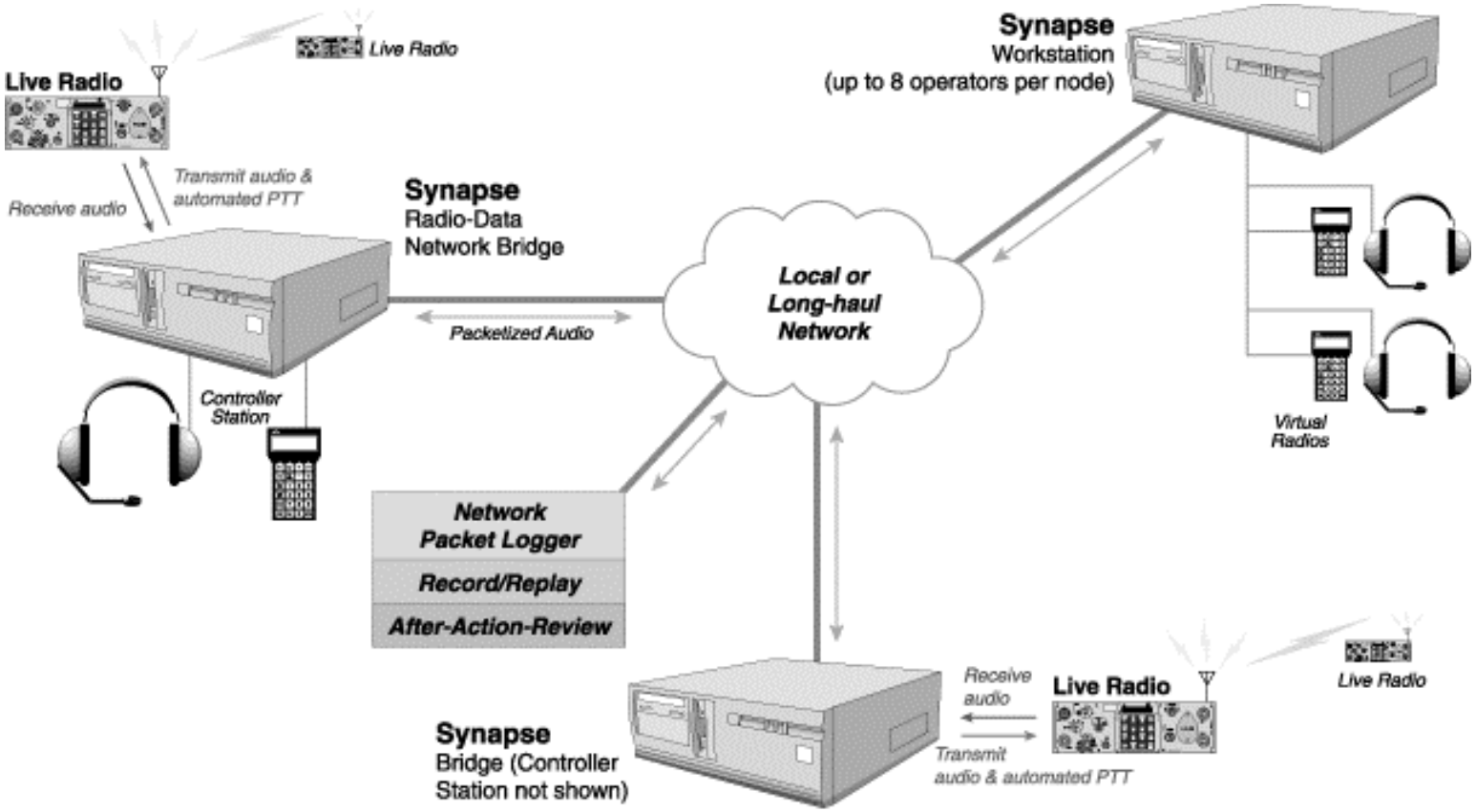
True 3-D Audio

- Why 3-D audio?
  - Spatially positioned voice streams and warning tones to simplify a complex audio environment and ease operator workload
- Key component of 3-D audio processing is the Head Related Transfer Function (HRTF)
  - Relates the spectral characteristics of an acoustic source at some location in 3-D space, to the spectral characteristics of the sound that reaches the eardrum
  - ASTi teamed with Bo Gehring of Focal Point Audio Technologies to implement HRTF filters

True 3-D Audio

- Implementation:
  - RIU codec maximum sample rate increased to 32 kHz for increased fidelity
  - HRTF implemented in DSP in RIU for scalability - Number of 3-D audio streams limited by number of RIU's, not the node CPU
  - Head Tracking capability to track operators head movements and adjust sound source location accordingly

Synapse System



Synapse System

- Link between live field radios and simulation networks
  - Base station radios receive audio over the air from field radios
  - Analog audio streams from base station radio are digitized, compressed and put into Ethernet packets
  - Ethernet packets are distributed onto the DIS network
  - Packets can be received at remote Synapse nodes anywhere on the network
  - Digital stream is transformed back into analog audio, and can be broadcast out other live radios if desired
  - Audio streams can be monitored, recorded, etc.
  - Instructors at Synapse workstation can participate in voice traffic using simulated radios

Conclusions

- Successfully demonstrated 3-D audio for crew intercom, radio communications, and warning tones in the VTT using an ASTi digital comms system
- System can be used to examine merits of a 3-D audio system in crew interface design